PRELIMINARY STATEMENT OF TORNADOES IN THE UNITED STATES DURING 1930

By HERBERT C. HUNTER

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In advance of the final study of the windstorms of 1930, which is expected to be finished during the summer of 1931, this preliminary statement, compiled from the material thus far assembled through the assistance of many, especially the several section directors, almost all of which was used in the monthly tables of "Severe local storms," is presented:

TORNADOES AND PROBABLE TORNADOES

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Number	0	0	8	5	82	36	13	7	17	2	17	0	187
Deaths	----	----	4	0	114	8	0	0	5	3	32	----	166
Damage [1]	----	----	678	48	6,865	1,969	113	85	654	50	642	----	11,104

TORNADIC WINDS AND POSSIBLE TORNADOES [2]

Number	0	2	1	0	3	2	0	0	0	0	2	0	10
Deaths	----	0	0	----	1	0	----	----	----	----	0	----	1
Damage [1]	----	52	6	----	250	13	----	----	----	----	6	----	327

[1] In thousands of dollars.
[2] Several of these, in the final study, will probably be classed as not tornadoes.

In reviewing the 1930 material, from which this tabular statement was prepared, and the final studies of the years just preceding, it was noted that at the end of 1930 a period of 39 months had gone without any one tornado in the United States causing property losses to the amount of $2,500,000, or the loss of as many as 50 lives. However, on a few occasions a group of tornadoes visiting one State during one day had together caused more than 50 fatalities. In the aggregate, the tornadoes of these 39 months resulted in losses of 539 lives, according to the best information at hand, and about $36,000,000 of property.

By contrast, the tornado record of the slightly longer period of 45 months next preceding may be summarized; that is, from the beginning of January, 1924, to the end of September, 1927. Within this 45-month period there occurred six tornadoes causing losses of more than 50 lives each, the counts actually ranging from 67 to 689, while three of the six caused property losses exceeding $10,000,000 each. The total figures of losses from the tornadoes of these 45 months were 1,848 lives and almost $97,000,000 of property.

NOTES, ABSTRACTS, AND REVIEWS

Dr. George C. Simpson on Thunder and Lightning [1]—*Abstracted and condensed by A. J. Henry.*—Doctor Simpson, in his opening paragraph, points out that while it is nearly 200 years since Dalibard and Franklin showed conclusively that lightning is an electric discharge there is as yet no unanimity of opinion as to the mechanism by which the electricity is generated in the thunderstorm. He believes that at present there are but two theories that are seriously considered, viz, those of C. T. R. Wilson [2] based on electrical induction, and the one based on the breaking of raindrops.[3] The latter theory starts from the observation that when a drop of water breaks up in the air there is a separation of electricity, the water becoming positively charged and the air negatively charged.

In all thunderstorms there are violent ascending air currents which hold up large amounts of water in the form of rain drops. These rain drops are constantly breaking and reforming and the air which streams past them becomes negatively charged. In this way there is a large separation of electricity, the cloud as a whole becoming more and more charged with negative electricity, while the water held in suspension in the ascending currents becomes very highly positively charged.

For a long time it was considered that a cloud is more or less a good conductor of electricity. It is now known, according to Doctor Simpson, that this is not the case, and that when electricity is separated into two parts of a cloud it remains as a volume charge. If the process which separates the electricity continues the charge goes on accumulating until the electrical field becomes so intense that the electrical resistance of the air breaks down and a lightning discharge passes.

When air is subjected to an electrical stress little happens until a certain field strength is reached when "electrical breakdown" occurs.

The breakdown is due to the splitting up of neutral air molecules into ions and electrons. Now, ions and electrons can move under an electrical field, and therefore when the air has broken down an electrical current can pass, the electricity being conveyed by the moving ions and electrons, especially the electrons which move several hundred times faster than the ions.

In a thunder cloud in which active separation of electricity is taking place the field increases until the electrical resistance of the air breaks down, generally at some point well within the cloud. At first the region of breakdown is very local but the rent, having once been started, rapidly extends in the form of a narrow channel; but the most important characteristic of such a rent is that it can only extend in one direction, that is, away from the seat of the positive electricity. As the channel extends, it tends to branch and each branch becomes a new rent. Thus when we see a lightning discharge we can tell from the branching which way it has extended and where the positive electricity is situated.

The rate at which a lightning channel grows is usually very great. It has not been possible to measure the rate of growth of a natural lightning channel; but from experiments made in the laboratory we know it can be as fast as one-tenth of the velocity of light. On the other hand, as I shall show later, the channel grows relatively slow. The light associated with a lightning flash is due to the recombination of electron and ions within the ionized channel. The first discharge which opens the channel leaves the air within the channel very highly ionized and so long as the channel remains ionized an electrical current can pass along it.

The current itself renews the ionization so that the channel continues to glow so long as a current passes. Recombination however, is relatively a slow process and the channel remains ionized for some appreciable time after the visible discharge has ceased.

The numerous different kinds of lightning are due to the different forms which the channel can take. Many

[1] The thirty-second Robert Boyle lecture, delivered before the Oxford Junior Scientific Club, June 7, 1930.
[2] Journal Franklin Institute, 208, p. 1, 1929.
[3] G. C. Simpson: Proceedings Roy. Soc. A: 114, p. 376, 1927.